NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

TREE/SHRUB ESTABLISHMENT

(Acre)

CODE 612

DEFINITION

Establishing woody plants by planting seedlings, container/potted plants, or cuttings, direct seeding, or natural regeneration.

PURPOSE

To establish woody plants for:

- forest products
- wildlife habitat
- long-term erosion control
- water quality improvement
- waste treatment
- air pollution reduction
- carbon sequestration
- energy production
- aesthetics.

CONDITIONS WHERE PRACTICE APPLIES

On any area where woody plants can be grown.

CRITERIA

General Criteria Applicable to All Purposes

Species will be adapted to site conditions and suitable for the planned purpose(s). Species considered invasive or noxious should not be used.

Planting or seeding rates will be adequate to accomplish the planned purpose.

Planting dates, and care in handling and planting of the seed, cuttings or woody plants will ensure that planted materials have an acceptable rate of survival.

Only viable, high quality and adapted planting stock or seed will be used.

Site preparation shall be sufficient for establishment and growth of selected species.

Adequate seed or advanced reproduction needs to be present or provided for when using natural regeneration to establish a stand.

Choose a planting method that is appropriate for existing site conditions and species capabilities.

Timing and use of equipment will be appropriate for the site and soil conditions.

The planting will be protected from adverse impacts from livestock, wildlife, pests and fire.

The planting shall not compromise the integrity of property lines, utilities, fences, right-of-ways, drainage tiles, or buildings.

Comply with applicable federal, state, and local laws and regulations during the installation, operation and maintenance of this practice.

Each site will be evaluated to determine if mulching, supplemental water or other cultural treatments will be needed to assure adequate survival and growth. Use supplemental water, mulching, root dips, geo-textile mats, tree shelters, and tree shades as necessary to ensure adequate survival.

Additional Criteria for Improving Water Quality

Use species that are native to the area, medium to fast growing, and deep rooting.

For riparian areas, use species adapted to local flooding conditions and soil wetness.

Additional Criteria for Wildlife Habitat

Use multiple native species (minimum of 3 or more species). No single species should make up more than 33% of the total number of species planted.

Select species which best meet wildlife and ecosystem needs.

Species selected will be indigenous to the site and will reflect species composition of the desired stands.

Additional Criteria to Provide Erosion Control

Plants should be evenly distributed over the planting site. Place plants on the contour.

Use non-competitive cover crops between planted rows on critical erosive slopes.

Additional Criteria for Carbon Sequestration

Select plant species that are adapted to the site to assure strong health and vigor. Plant the full stocking rate for the site.

For optimal carbon sequestration, select plants that have higher rates of sequestration in biomass and soils.

When using trees and shrubs for greenhouse gas reductions, prediction of carbon sequestration rates shall be made using current, approved carbon sequestration modeling technology.

Additional Criteria to Treat Waste

Use species that have fast growth characteristics, extensive root systems, high nutrient uptake capabilities, and potential for wood/fiber products in short rotations.

CONSIDERATIONS

When underplanting, trees should be planted sufficiently in advance of overstory removal to ensure full establishment.

Prescribed burning may be required for natural regeneration of serotinous cone species and for site preparation for other species.

Consideration will be given to plant materials that have been selected and tested in tree improvement programs.

Plans for landscape and beautification plantings should consider foliage color, color and season of flowering, and mature plant height.

Tree arrangement and spacing should allow for needed access lanes.

Residual chemical carryover should be evaluated prior to planting.

Applications of nutrients may be needed to maintain plant vigor or improve planting survival.

Use of locally adapted seed, seedlings or cuttings is recommended.

OPERATION AND MAINTENANCE

The following actions shall be carried out to insure that this practice functions as intended throughout its expected life. These actions include normal repetitive activities in the application and use of the practice, and repair and upkeep of the practice.

Competing vegetation will be controlled until the woody plants are established.

Check for insect and disease damage with annual inspections. Seek professional assistance for diagnosis and control measures.

Maintain necessary firebreaks around all plantings.

Replanting will be required when survival is inadequate. (See **Table 1**)

Trees and shrubs will be protected from fire, insects, disease, and animals until established.

PLANS AND SPECIFICATIONS

Specifications for applying this practice shall be prepared for each site and recorded using approved specification sheets, job sheets, and narrative statements in the conservation plan, or other acceptable documentation.

PRACTICE SPECIFICATIONS

The following table can be used as a guide in choosing suitable planting stock or seed:

Site	Planting Stock
Open Fields	1,2,3,5
Understocked Woodland	1,2,5
Landscaping	1,2,3,4,5
Environmental	1,2,3,5

1 = Bare-root; 2 = Container grown; 3 = Cutting; 4 = Balled & burlap; 5 = Direct seeding

Bare-root: Plant large diameter seedlings with well-branched, fibrous root systems. Discard any diseased or damaged seedlings. For underplanting hardwoods, use stock at least 3/8 inch in stem diameter.

Container grown: Use healthy, well-developed plants. Discard any diseased or damaged material.

Included as container plants are potted, air root-pruned plants. These plants are developed through a multi-step growing program that produces a dense, fibrous root system creating a plant with improved survivability and growth characteristics.

Cuttings: Use cuttings prepared during the dormant season from wood of the previous season's growth. The cuttings should be taken from healthy, moderately vigorous stock plants growing in full sunlight. At least two nodes should be included in the cutting. The minimum size of cuttings should be 1/4 inch in diameter and 8 inches in length.

Balled and burlap: Use plant stock that is 18 inches or more in height for shrubs and 36 inches or more in height for trees. Do not use plants with cracked or broken rootballs. Avoid plants with root systems that are visible on the rootball surface and that circle the trunk.

Direct seeding: Use viable, mature seed.

Care of planting stock

Protect stock from desiccation during temporary storage and delivery to the planting site. Keep all types of planting stock, except the ones needed immediately for a supply during planting, stored in a cool environment (< 50 degrees F) out of direct sunlight and wind. Do not plant into frozen soil. Avoid planting on hot, windy days. A cool, cloudy day is preferred.

Cuttings: Plant cuttings within 2 days of collection or shipping arrival. If planting will be delayed, place cuttings in moist sand/paper, sphagnum moss, or plastic bags and store in a cool (34-40 degrees F) place.

Seedlings: Seedlings should be promptly examined in the shipping container and watered or re-wrapped in moist packing material. Survival can be increased by dipping roots in a commercial water-absorbing gel before planting or by soaking seedlings in water 1 to 2 hours before planting.

Plant as soon as possible after materials arrive, preferably the day of delivery. If planting will be delayed for more than 5 days, keep seedlings in shipping container and place in cold storage at 35 to 45 degrees F. If cold storage is not feasible or available, seedlings should be heeled-in. Dig a trench a little deeper than the root systems and spread roots against the back of the trench. Cover roots completely with soil, tamped to eliminate air spaces. Water as needed to keep roots moist but not wet.

Container grown: Container grown stock should be kept in its container and its soil kept moist (field capacity). Thoroughly water plants 2 days before planting. This will facilitate removal from containers during planting.

Direct seeding: Keep seeds cool. Maintain a seed moisture content of 30-50%. Do not allow seed to mold. If seeds are field collected, place seeds in porous bags to prevent heat buildup. Keep seeds cool and stratify if necessary. For further information on seed collection and handling, refer to NRCS FORESTRY TECHNICAL NOTE MO-18, Seed Collection Guide.

Balled and burlap: Keep the rootball moist by watering slowly from the top. Wet the foliage occasionally. Balled planting stock can be held temporarily by placing soil or mulch around the entire ball of the tree and keeping it moist.

Planting Dates

Bare-root stock and cuttings. Use the following guidelines for bare-root stock and cuttings:

Planting Zone 1: March 1 - June 1[a]
Planting Zone 2: February 15 - May 15[a]
Planting Zone 3: December 1 - May 15[a]

A two-week variance in the above dates may be used if the ground is not frozen and/or adequate soil moisture is present.

[a] All Planting Zones - *Soil map units with frequent, long or very long duration flooding* (Use Section II, Water Features of the eFOTG for guidance.): Planting may be extended to **July 1** because of spring flooding. (Adequate soil moisture must be present at the time of planting)

Frequent flooding: *flooding typically occurs once every other year;* ***Long duration****: 7 to 30 continuous days of flooding;* ***Very long duration****: more than 30 continuous days of flooding.*

See Figure 1 for woody planting Zones.

Balled and burlap and container grown stock. Plant at any time of the year that the ground is not frozen and adequate soil moisture is present.

Seed. Tree/shrub seed may be planted from November through April anytime that soil and site conditions allow (do not seed into frozen soil). Non-stratified seed should be planted before January 1. Spring seeding can reduce rodent and insect damage. Fall seeding can eliminate the need for stratification. Acorns of most species in the white oak group have little or no dormancy and should be planted as soon as possible after collection in the fall.

Site preparation

Based on cover present, follow guidelines in FOREST SITE PREPARATION (490).

Planting methods

Seedlings: Plant seedlings upright at the same depth or slightly deeper (1 inch) than the stock was growing in the nursery or container.

Properly planted seedlings should resist gentle lifting pressure.

Check each planted row for proper planting depth and root position and for adequate soil packing around the roots.

Cuttings: Plant cuttings at an angle of 45 to 60 degrees with buds pointing upward. (If cuttings are planted straight up, the soil often settles away from them in dry weather.) Leave 2 good buds above ground.

Balled and burlap/containerized: Dig a hole large enough to hold root ball or container volume. Remove plants from containers before placing in the ground. If plants are in tarpaper pots, the tarpaper should be slit along each side or removed before placing in the ground. Place stock at same depth it grew at the nursery and firmly pack soil around roots to eliminate air pockets.

Direct seeding: Care must be taken to completely cover the seed and achieve good soil-seed contact. One or more of the following seeding methods should be used:

- Broadcast: Broadcast the seed evenly over the planting area and cover seeds with mineral soil (1/2 to 1 inch).
- Strip: Broadcast the seed evenly over the prepared strips and cover with mineral soil (1/2 to 1 inch).
- Spot: Plant 2 to 3 seeds per spot, 2 inches deep. Seal planting hole.
- Machine: Plant seeds 1 to 2 inches deep. Cover with mineral soil.

Natural regeneration: The use of a natural seed source may be used under the following conditions:

- Areas that experience frequent flooding.
- Depression areas too wet to machine or hand plant.
- Sites likely to be invaded by soft-mast or light seed species.

- Sites that are within 300 feet of existing mature woodlands and adjacent to desirable seed sources.

Planting Rates

General

Direct Seeding: Use a minimum of 1500 seeds per machine or hand planted acre. Use 3000 seeds per acre for broadcast seeding.

Seedlings, cuttings, or containers (liners only): The following planting rates shall be used for woody species. Adjust rates within listed ranges for desired objectives, site conditions, maintenance requirements, and species needs.

Hardwood trees	302 - 544 plants/acre
Shrubs	727 – 1742 plants/acre
Conifers	605 - 726 plants/acre
Biofuels	907 - 1210 plants/acre

Plants required per acre for selected spacing:

Spacing (feet)	Plants per acre
5 x 5	1742
6 x 6	1210
6 x 8	907
6 x 10	726
7 x 10	622
7 x 7	889
8 x 8	680
8 x 9	605
9 x 9	538
8 X 10	544
10 x 10	436
10 x 12	363
11 x 11	360
12 x 12	302
14 x 14	222
16 x 16	170
18 x 18	134
20 x 20	109
30 x 30	48

Container (≥2 gallon): Plant 48 trees per acre (30 x 30 or equivalent). Adjust rates up or down to accommodate site conditions or desired objectives.

Christmas Trees

For Christmas tree production a minimum of 1210 plants/acre is recommended. Landowner equipment and objectives must be considered in the planting design/layout.

Alley Cropping

Base plant spacing upon the type of alley cropping system being developed. Use within row spacing distances under **Planting Rates**, *Wind Erosion, Energy Conservation, Odor Control and Snow Control*. See ALLEY CROPPING (311) for between row spacing guidance.

Silvopasture

Spacing distance between woody plants and row sets should be based on landowner objectives, tree and shrub environmental requirements, light requirements and growth periods of the forage, and machinery width needs.

Plant trees in single, double or triple row sets. Cluster plantings may also be used. When multiple row woody planting sets are used, stagger within row plantings.

Within row spacing for sets should be:

small shrubs (< 8 ft)	3-6 feet
large shrubs	5-8 feet
evergreens	8-12 feet
deciduous trees	8-12 feet

Between row spacing for sets should be:

between shrub rows	6-10 feet
between tree rows	10-12 feet
between tree/shrub	10-12 feet

Wildlife Habitat

For tree species, use any of the minimum planting rates under **Planting Rates**, *General*.

For shrub plantings, use one of the following guidelines:

- see UPLAND WILDLIFE HABITAT MANAGEMENT (645)

- use a minimum of 726 plants per acre (6x10, 5x12 spacing or equivalent)
- use shrub spacing guidelines listed under *Wind Erosion, Energy Conservation, Odor Control and Snow Control.*

For direct seeding wildlife habitat development or wetland restoration, a minimum rate of 750 seeds per acre should be used, provided there is an adequate mature tree seed source of desired species within 300 feet. If a mature seed source is not close, use 1500 seeds per planted acre.

For specialized wildlife planting areas refer to the appropriate standard(s) for guidance.

Wind Erosion, Energy Conservation, Odor Control and Snow Control

Per acre planting rates will vary according to the extent of the planting and individual site plans. Base per acre rates on the following spacing:

Within the row spacing will be:

small shrubs (< 8 ft)	3-6 feet
large shrubs	5-8 feet
evergreens	8-12 feet
deciduous trees	8-15 feet

Between the row spacing will be:

between shrub rows	6-12 feet
between tree rows	12-20 feet
between tree/shrub	10-20 feet
between rows (odor)	20-50 feet

Use widest spacing when using large (≥2 gallon) container grown plants or balled & burlap stock.

Beautification

Per acre planting rates will vary according to the extent of the planting and individual site plans.

Adapted Species

Base selection on soil type, site limitations, landowner objectives, landscape characteristics, and geographic location.

For guidance on species selection refer to Missouri eFOTG, Section II, Statewide Soil and Site Information – Woodland, and Section IV, practice standards: WILDLIFE UPLAND HABITAT MANAGEMENT (645), HEDGEROW PLANTING (422), RIPARIAN FOREST BUFFER (391), ALLEY CROPPING (311), WINDBREAK/ SHELTERBELT ESTABLISHMENT (380), and RESTORATION AND MANAGEMENT OF DECLINING HABITATS (643).

Weed Control

Provide a 3-4 feet (diameter) competition free zone around all woody plantings.

If mulches (including weed mats) are used, follow MULCHING (484).

If herbicides are used, apply them only when needed and handle with care. Follow all label directions and precautions.

If herbicides are not handled or applied properly, they may be injurious to humans, animals, fish, wildlife, desirable plants, and pollinating insects and may contaminate water supplies.

If mechanical means are used, care should be taken to avoid physical damage to plantings. Keep tillage depths shallow to avoid root damage.

If temporary cover is used, follow criteria to control erosion in COVER AND GREEN MANURE CROP (340).

If living mulches are used, use one of the following species at the specified rates to control weed competition:

Species	Rate - PLS/Ac
Ladino clover	*3.0 lbs*
Alsike clover	*3.2 lbs*
Red clover	*6.1 lbs*

Note: Above rates are for good planting conditions. Increase rates by 50% for fair planting conditions.

Use of living mulches may cause an increase in rodent or deer damage to the woody planting.

REFERENCES USED IN PREPARATION OF THIS STANDARD

A Guide to Bottomland Hardwood Restoration; USGS/USDA Forest Service; General Technical Report SRS-40; 2001.

Trees for Conservation: Planning, Planting and Care; CSFS No. 114; Colorado State Forest Service; 1985.

Plant Propagation Principles and Practices, third edition; Prentice-Hall, Inc.; 1976.

Seeding and Planting Hardwoods; in Central Hardwood Notes; USDA Forest Service; 1989.

Seeding and Planting Pines; in Central Hardwood Notes; USDA Forest Service; 1989.

Planting Trees for Farmstead Shelter; Extension Bulletin 196; University of Minnesota; 1980.

Forestry Handbook - Second Edition: Society of American Foresters; Ronald Press; 1984.

Seeds of Woody Plants in the United States: Agricultural Handbook No.450; USDA Forest Service; 1974.

Care and Planting of Southern Pine Seedlings; USDA Forest Service; Management Bulletin R8-MB39; 1989.

Figure 1. Tree/shrub planting zones for Missouri.

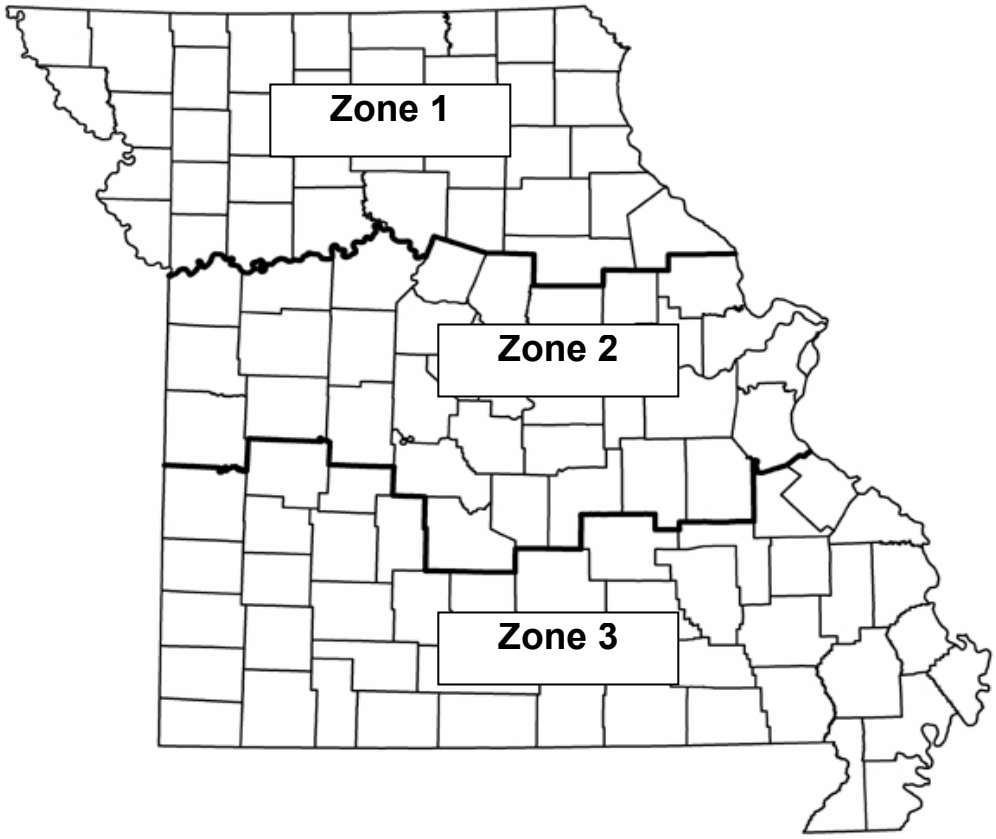

Table 1. This table gives survival guidelines for tree/shrub plantings and presumes that the minimum number of trees and/or shrubs were originally planted based on acceptable design and site objectives. Required survivability of individual plants will vary with the purpose of the planting.

Survival Guidelines For Tree/Shrub Plantings

(Inventoried after "leaf out" during spring or summer of the second year (% or number))

Practice	*Survival Percent or Number*
380 - Windbreaks/Shelterbelt Establishment Sound Barrier Visual Screen Snow protection Wind/air quality protection Living snow fence 311- Alley Cropping	• 90 % of all trees and shrubs planted with no two adjacent within row plants missing for all purposes.
Any ball and burlap or ≥2 gallon container planting	• 80 % of any planting rate purpose.
391 - Riparian Forest Buffer 422 - Hedge Row Planting 612 - Tree/Shrub Establishment - General 580 - Streambank/Shoreline Protection 381 - Silvopasture Establishment 643 – Restoration and Management of Declining Habitats (oak savanna; bottomland forest)	• 200 plants/ac for any establishment method* or 67% of the original planting rate. Surviving plants should be evenly distributed over the planting area.
644 - Wetland Wildlife Habitat Management 645 - Wildlife Upland Habitat Management	• 150 plants/ac for any establishment method* or 50% of the original planting rate. Surviving plants should be evenly distributed over the planting area.

* Includes sites using direct seeding or natural regeneration.